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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/576,134	07/13/2007	Enrique V. Barrera	11321-P074WOUS	5500

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EXAMINER	
CHOI, PETER Y	
ART UNIT	PAPER NUMBER
1786	

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Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Office Action Summary	Application No.	Applicant(s)	
	10/576,134	BARRERA ET AL.	
	Examiner	Art Unit	
	PETER Y. CHOI	1786	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE *3* MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *23 March 2011*.

2a)☒ This action is **FINAL**. 2b)☐ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *41,43,45-53,55-69,71 and 72* is/are pending in the application.

4a) Of the above claim(s) *50-53,55-67,71 and 72* is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *41,43,45-49,68 and 69* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on *17 April 2006* is/are: a)☒ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☐ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .
5) ☐ Notice of Informal Patent Application
6) ☐ Other: _____.

DETAILED ACTION

Claim Rejections - 35 USC § 103

1. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

2. Claims 41 and 45-47 are rejected under 35 U.S.C. 103(a) as obvious over US Pub. No. 2005/0191490 to Ton-That in view of USPN 6,270,897 to Flautt.

Regarding claims 41 and 45-47, Ton-That teaches a composite material, comprising carbon nanotubes, a fiber reinforcement material, and a polymer (Ton-That, Abstract; *see additionally* paragraphs 0002-0022, 0025-0030, 0034-0042, 0050-0056, 0064, 0075, 0077, 0078). Ton-That teaches that the carbon nanotubes are treated with organophilic modifiying compounds to enhance physical and chemical interaction between the nano-reinforcing material and an epoxy group of an epoxy-functionalized graft polymer (Id., paragraph 0029). Ton-That teaches that the organophilic modifying compounds may include silanes (Id.) and that the polymer is an epoxy (Id., Abstract, 0052-0076).

Ton-That teaches that the composite material may comprise various additives such as glass fibers (paragraphs 0077, 0078). Additionally, the choice of incorporating glass fibers would have been obvious to one of ordinary skill in the reinforcing composite material art at the time the invention was made, as Ton-That teaches the suitability of glass fibers in the reinforcing composite, and including glass fibers would have been obvious based on the desired tensile and flexural strength of the composite suitable for the intended application.

Ton-That does not appear to teach that the glass fibers are silane-functionalized. However, Flautt teaches a substantially similar glass fiber reinforced composite material comprising glass fibers and an epoxy matrix (Flautt, column 1 line 7 to column 5 line 10, claims 1-14). Flautt teaches that sizing the glass fibers with an organosilane reduces interfilament abrasion, and improves compatibility of the fibers with the epoxy matrix material of the composite structure.

Therefore, it would have been obvious to one of ordinary skill in the composite art at the time the invention was made to form the composite material of Ton-That, wherein the glass fibers are sized with an organosilane, as taught by Flautt, motivated by the desire of forming a conventional composite material wherein the interfilament abrasion of the glass fibers is reduced, the compatibility of the fibers with the epoxy matrix material is improved, and the physical properties of the composite material is enhanced.

Regarding the claimed covalent bonding, each of Ton-That and Flautt independently teaches the incorporation of an organosilane with each of the nanofibers and the glass fibers, and the attendant advantages. Additionally, based on the combined teachings of Ton-That and Flautt, it is reasonable for one of ordinary skill in the art to expect that functionalizing the carbon nanotubes increases the number of bonding sites between the carbon nanotubes and the epoxy resin, and that functionalizing the glass fibers with a silane improves bonding with the epoxy resin and the carbon nanotubes, since the nanotubes are additionally functionalized with a silane.

As set forth above, the prior art combination teaches a substantially similar structure and composition as the claimed invention. Additionally, based on Applicants' specification and Applicants' submissions of June 28, 2010, the organosilane-functionalized glass fibers will

naturally covalently bond with the organosilane-functionalized carbon nanotubes. Therefore, it is reasonable for one of ordinary skill in the art to expect that once the prior art combination is formed, the carbon nanotubes will covalently bond to both the fiber reinforcement material and the epoxy resin, as both the glass fibers and the carbon nanotubes are organosilane-functionalized, and functionalizing the carbon nanotubes increases the number of bonding sites to the epoxy resin.

3. Claim 43 is rejected under 35 U.S.C. 103(a) as being unpatentable over Ton-That in view of Flautt, as applied to claims 41 and 45-47 above, and further in view of "Single-Walled Carbon Nanotube-Polymer Composites: Strength and Weakness" to Ajayan.

Regarding claim 43, Ton-That does not appear to teach that the carbon nanotubes are single-walled nanotubes. Since Ton-That is silent as to the type of nanotubes, it would have been necessary and therefore obvious to look to the prior art for conventional nanotubes suitable for use in composites. Ajayan provides this conventional teaching, showing that it was known in the composite art to form composites comprises carbon nanotube and epoxy composites, wherein the carbon nanotubes comprise single-walled nanotubes (Ajayan, pages 750-753). Ajayan teaches that various properties are known and attributed to carbon nanotubes, specifically single-walled carbon nanotubes. Additionally, Ajayan teaches that including single-walled carbon nanotubes in nanotube-epoxy composites increases the toughness of the composites by absorbing energy, strength and flexibility. It would have been obvious to one of ordinary skill in the composite art at the time the invention was made to form the composite of Ton-That, wherein the carbon nanotubes comprise single-walled carbon nanotubes, as taught by Ajayan, motivated by

the desire of forming a conventional nanotube-epoxy composite comprising nanotubes known in the art as predictably suitable for use in such composites to increase the toughness of the composites by absorbing energy, strength and flexibility.

4. Claims 48 and 49 are rejected under 35 U.S.C. 103(a) as being unpatentable over Ton-That in view of Flautt, as applied to claims 41 and 45-47 above, and further in view of USPN 3,312,569 to Philipps.

Regarding claims 48 and 49, the prior art combination does not appear to teach that the glass fibers are in a form of woven sheets, and that the woven sheets are stacked together with the silane-functionalized carbon nanotubes and the polymer between them. Since the prior art combination does not appear to teach in what form the glass fibers are employed, it would have been necessary and therefore obvious to look to the prior art for conventional forms of glass fibers in composites. Philipps teaches that it was known in the reinforced composite art to form a glass fiber reinforced composite comprising glass fibers and an epoxy resin, wherein the glass fibers are in the form of woven mats (Philipps, column 1 line 14 to column 4 line 35, column 7 line 15 to column 8 line 68). It would have been obvious to one of ordinary skill in the reinforced composite art at the time the invention was made to form the reinforced composite of the prior art combination, wherein the glass fibers are in the form of woven sheets, as taught by Philipps, motivated by the desire of forming a conventional reinforced composite comprising glass fibers in forms known in the art as being predictably suitable for use in reinforced composites, based on the strength and flexural characteristics suitable for the intended application, as woven sheets will predictably comprise increased dimensional stability.

Regarding claim 49, although the prior art combination does not appear to specifically teach that the carbon nanotubes and the polymer are between the stacked sheets, it naturally flows from the prior art combination that the woven glass fibers are employed in an epoxy resin composite, and uniformly dispersing the constituents of the composite, such as the nanotubes, glass fibers, and epoxy resin, in the composite enhances the uniformity of the physical and chemical characteristics of the composite. Therefore, it would have been obvious to one of ordinary skill in the reinforced composite art at the time the invention was made to form the reinforced composite of the prior art combination, wherein the carbon nanotubes and polymer are between the woven sheets, motivated by the desire of forming a conventional reinforced composite comprising uniform physical and chemical characteristics, such that the composite comprises the desired strength, flexural characteristics, and dimensional stability suitable for the intended application.

5. Claims 68 and 69 are rejected under 35 U.S.C. 103(a) as being unpatentable over Ton-That in view of Flautt, as applied to claims 41 and 45-47 above, and further in view of "Chemical Functionalization of Carbon Nanotubes Through an Organosilane" to Velasco-Santos.

Regarding claims 68 and 69, Ton-That does not appear to teach the specific formula of the silane-functionalized carbon nanotubes. Since Ton-That is silent as to the specific formula of the silane-functionalized carbon nanotubes, it would have been necessary and therefore obvious to look to the prior art for conventional silane coupling agents.

Velasco-Santos provides this conventional teaching, showing that it was known in the reinforced composite art to form reinforced composites comprising a matrix and carbon

nanotubes, wherein the nanotubes are functionalized with an organo-functionalized with a silane compling agent chemically described as R-Si-R', wherein the R group is chosen to be reactive depending on the organic matrix used, which readily reacts with hydroxyl groups produced through oxidation on the nanotube surface (Velasco-Santos, pages 495-498). Velasco-Santos teaches that the hydroxyl-functionalized carbon nanotubes are further silane functionalized with a silation reagent such as silanol (Id.). Velasco-Santos teaches that attaching the organo-functional groups to the nanotubes improves their chemical compatibility with specific polymers. It would have been obvious to one of ordinary skill in the reinforced composite art at the time the invention was made to form the reinforced composite of Ton-That, wherein the nanotubes comprise hydroxyl groups and are silane-functionalized as set forth in Velasco-Santos, motivated by the desire of forming a conventional reinforced composite with improved chemical compatibility when joining the nanotubes to the matrix. Additionally, as Velasco-Santos teaches that the R group is chosen to be reactive depending on the organic matrix used (*see* Id., page 495), it would have been obvious to one of ordinary skill in the reinforced composite art at the time the invention was made to choose a suitable R group to be reactive with an epoxy matrix, as Velasco-Santos suggests that it is within the level of ordinary skill to choose a suitable constituent to be reactive with an epoxy matrix, based on the desired compatibility of the materials and characteristics of the reinforced composites suitable for the intended application.

Regarding the specifically claimed method of preparing the hydroxyl-functionalized carbon nanotubes, such a method of preparing is interpreted as a product-by-process limitation. Absent a showing to the contrary, it is Examiner's position that the article of the applied prior art is identical to or only slightly different than the claimed article. Even though product-by-process

claims are limited by and defined by the process, determination of patentability is based on the product itself. The patentability of a product does not depend on its method of production. If the product in the product-by-process claim is the same as or obvious from a product of the prior art, the claim is unpatentable even though the prior product was made by a different process. *In re Thorpe*, 227 USPQ 964, 966 (Fed. Cir. 1985). The burden has been shifted to Applicant to show unobvious differences between the claimed product and the prior art product. *In re Marosi,* 218 USPQ 289 (Fed. Cir. 1983). The applied prior art either anticipated or strongly suggested the claimed subject matter. It is noted that if Applicant intends to rely on Examples in the specification or in a submitted declaration to show unobviousness, Applicant should clearly state how the Examples of the present invention are commensurate in scope with the claims and how the Comparative Examples are commensurate in scope with the applied prior art.

6. Claims 68 and 69 are rejected under 35 U.S.C. 103(a) as being unpatentable over Ton-That in view of Flautt, as applied to claims 41 and 45-47 above, and further in view of Applicants' specification and "Chemical Functionalization of Carbon Nanotubes Through an Organosilane" to Velasco-Santos.

Regarding claims 68 and 69, the prior art combination appears to render obvious the claimed invention. Additionally, Applicants' specification teaches that prior art hydroxyl-functionalized carbon nanotubes include structures set forth in Figures 1 and 2 of Applicants' specification and set forth below:

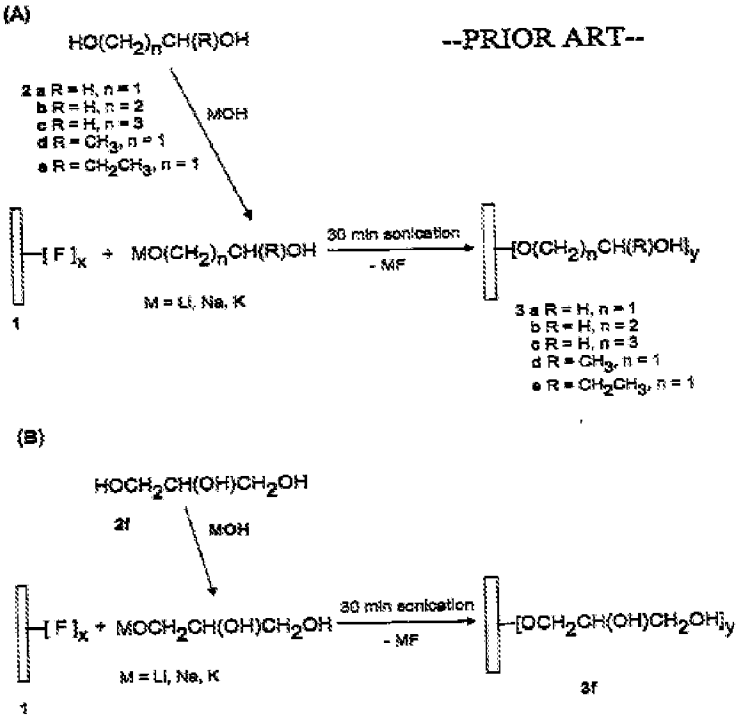

Fig. 1

--PRIOR ART--

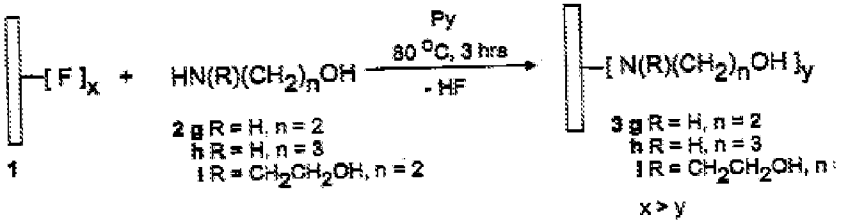

Fig. 2

Additionally, Velasco-Santos teaches that the silane compling agent is chemically described as R-Si-R', wherein the R group is chosen to be reactive depending on the organic matrix used, which readily reacts with hydroxyl groups produced through oxidation on the nanotube surface (Velasco-Santos, pages 495-498). Velasco-Santos teaches that attaching the organo-functional groups to the nanotubes improves their chemical compatibility with specific polymers. It would have been obvious to one of ordinary skill in the reinforced composite art at the time the invention was made to form the reinforced composite of the prior art, wherein the nanotubes are comprise hydroxyl groups and are silane-functionalized as set forth in Velasco-Santos and wherein the carbon nanotubes are hydroxyl-functionalized as set forth in Applicants' specification, as Applicants' specification teaches that hydroxyl functionalized carbon nanotubes as set forth in Figures 1 and 2 of Applicants' specification were known, and motivated by the desire of forming a conventional reinforced composite with improved chemical compatibility when joining the nanotubes to the matrix. It should be noted that absent evidence to the contrary, the claimed structures would appear to result once the prior art combination is formed.

Regarding the specifically claimed method of preparing the hydroxyl-functionalized carbon nanotubes, such a method of preparing is interpreted as a product-by-process limitation. Absent a showing to the contrary, it is Examiner's position that the article of the applied prior art is identical to or only slightly different than the claimed article. Even though product-by-process claims are limited by and defined by the process, determination of patentability is based on the product itself. The patentability of a product does not depend on its method of production. If the product in the product-by-process claim is the same as or obvious from a product of the prior art, the claim is unpatentable even though the prior product was made by a different process. *In re*

Thorpe, 227 USPQ 964, 966 (Fed. Cir. 1985). The burden has been shifted to Applicant to show unobvious differences between the claimed product and the prior art product. *In re Marosi,* 218 USPQ 289 (Fed. Cir. 1983). The applied prior art either anticipated or strongly suggested the claimed subject matter. It is noted that if Applicant intends to rely on Examples in the specification or in a submitted declaration to show unobviousness, Applicant should clearly state how the Examples of the present invention are commensurate in scope with the claims and how the Comparative Examples are commensurate in scope with the applied prior art.

Response to Arguments

7. Applicants' arguments filed March 23, 2011, have been fully considered but they are not persuasive. Applicants argue that Ton-That and Flautt are completely silent regarding covalent bonding of any kind between carbon nanotubes and a fiber reinforcement material. Examiner respectfully disagrees. Under 35 U.S.C. 103 (a), the obviousness of an invention cannot be established by combining the teachings of the prior art references absent some teaching, suggestion, incentive, or predictability supporting the combination. *ACS Hospital Systems, lnc. v. Montefiore Hospital*, 732 F.2d 1572, 1577, 221 USPQ 929, 933 (Fed. Cir. 1984); *KSR International Co. v. Teleflex Inc.*, 82 USPQ2d 1385, 1395-97 (2007). This does not mean that the cited prior art references must specifically suggest making the combination. *B.F. Goodrich Co. M Aircraft Braking Systems Corp.,* 72 F.3d 1577, 1582, 37 USPQ2d 1314, 1318 (Fed. Cir. 1996); *ln re Nilssen*, 851 F.2d 1401, 1403, 7 USPQ2d 1500, 1502 (Fed. Cir. 1988)). A suggestion or motivation to combine references is an appropriate method for determining obviousness, however it is just one of a number of valid rationales for doing so. The test for

obviousness is what the combined teachings of the prior art references would have suggested to those of ordinary skill in the art. *In re Young*, 927 F.2d 588, 591, 18 USPQ2d 1089, 1091 (Fed. Cir. 1991); *ln re Keller*, 642 F.2d 413, 425, 208 USPQ 871, 881 (CCPA 1981). This test requires us to take into account not only the specific teachings of the prior art references, but also any inferences which one skilled in the art would reasonably be expected to draw therefrom. *ln re Preda*, 401 F.2d 825, 826, 159 USPQ 342, 344 (CCPA 1968).

A patent for a combination, which only unites old elements with no change in their respective functions, obviously withdraws what is already known into the field of its monopoly and diminishes the resources available to skillful men. *KSR* at 1395. When a patent simply arranges old elements with each performing the same function it had been known to perform and yields no more than one would expect from such an arrangement, the combination is obvious. *Sakraida v. AG Pro, Inc.*, 425 U.S. 273 (1976).

As set forth above, based on the totality of the teachings of the prior art combination, it would have been obvious to one of ordinary skill in the composite art at the time the invention was made to form the composite material of Ton-That, wherein the glass fibers are sized with an organosilane, as taught by Flautt, motivated by the desire of forming a conventional composite material wherein the interfilament abrasion of the glass fibers is reduced, the compatibility of the fibers with the epoxy matrix material is improved, and the physical properties of the composite material is enhanced.

Regarding the claimed covalent bonding, each of Ton-That and Flautt independently teaches the incorporation of an organosilane with each of the nanofibers and the glass fibers, and the attendant advantages. Additionally, based on the combined teachings of Ton-That and Flautt,

it is reasonable for one of ordinary skill in the art to expect that functionalizing the carbon nanotubes increases the number of bonding sites between the carbon nanotubes and the epoxy resin, and that functionalizing the glass fibers with a silane improves bonding with the epoxy resin and the carbon nanotubes, since the nanotubes are additionally functionalized with a silane.

As set forth above, the prior art combination teaches a substantially similar structure and composition as the claimed invention. Additionally, based on Applicants' specification and Applicants' submissions of June 28, 2010, the organosilane-functionalized glass fibers will naturally covalently bond with the organosilane-functionalized carbon nanotubes. Therefore, it is reasonable for one of ordinary skill in the art to expect that once the prior art combination is formed, the carbon nanotubes will covalently bond to both the fiber reinforcement material and the epoxy resin, as both the glass fibers and the carbon nanotubes are organosilane-functionalized, and functionalizing the carbon nanotubes increases the number of bonding sites to the epoxy resin.

Applicants argue that Ajayan, Philipps, and Velasco-Santos additionally fail to remedy the noted deficiencies of Ton-That and Flautt, as each of Ajayan, Philipps, and Velasco-Santos do not teach or suggest covalent bonding to a fiber reinforcement material. Examiner respectfully disagrees. As set forth above, it is reasonable for one of ordinary skill in the art to expect that once the prior art combination is formed, the carbon nanotubes will covalently bond to both the fiber reinforcement material and the epoxy resin, as both the glass fibers and the carbon nanotubes are silane-functionalized, and functionalizing the carbon nanotubes increases the number of bonding sites to the epoxy resin.

Conclusion

8. Applicant's amendment necessitated any new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to PETER Y. CHOI whose telephone number is (571)272-6730. The examiner can normally be reached on Monday - Friday, 08:00 - 15:00.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Jennifer Chriss can be reached on (571) 272-7783. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

Peter Y Choi /PYC/
Examiner, Art Unit 1786

/Andrew T Piziali/
Primary Examiner, Art Unit 1798